SISTER CLUB

DKØEE

# the CARRIER.....

Published Monthly by the Mount Diablo Amateur Radio Club

MDARC FIELD DAY CALL W6CX | 2M REPEATER W6CX/R | 220 REPEATER W6CX/R | MEMORIAL CALLSIGN W6LGW

VOLUME XXXIII | March 1985 | ISSUE NO. 3

WE WILL WIN

## CLUB CALENDAR

15 March MDARC AUTCION Doors open at 6PM auction starts at 7 PM
17 March St Patricks day
18 March MDARC Board Meeting address below
20 March R R R G Meeting 8:00 PM at the Thurman Casey Library 2661 Oak Grove Road Walnut Creek
14 April Run for Daylight American Cancer So
20 April Spring Trail Ride Mt Diablo Horsemens Assoc

## NETS

"Let's get a little action going"
MDARC GENERAL NET
Thursdays 7:30 P.M. 147.66/06
Emergency NET is 146.43 Simplex 7 P.M.
then QSY to 7.735 after roll call Thurs.
Parky NET
Every night 3895 ± QRM 10 P.M.
NTS/NCN 3630 KHZ 7 P.M. daily
slow speed session 8:30 P.M.
NCN/VHF 145.41 MHZ WA6EUZ/R 7:30 P.M.
CCRA NET Mon. 7:35 P.M. 147.735

The Rocky Ridge Repeater Group of the MDARC meets every two months to welcome new members and refresh ideas with old.

## MEETING NOTICE

This month's meeting will be held at
The Grace Presbyterian Church
2100 Tice Valley Blvd.
at 6:00 P.M.

**MDARC AUCTION**

**March 15, 1985**

**SEE AUCTION RULES INSIDE**

**THINK QUALITY**

**BRING QUALITY**

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Executive Asst: Florence Lortsher Printer: David Lortsher

| | | | | |
|---|---|---|---|---|
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| BOARD MEMBER | KT6Y | JAY CALDIS | 2890 GRANDE CAM. W.C. | 939-1893 |

DEADLINE FOR NEXT ISSUE: Articles, Classified Ads, etc. by March 26 1985

Next Board Meeting at: Rick & Dee Barber, 3141 Milner Rd. Antioch March 18 1985 8:00 PM

# MDARC General Meeting

GENERAL MEETING MDARC FEB 15 1985

The meeting was called to order by our President Rick WB6EZI at 8:04 P.M
VISITORS were introduced and welcomed
UPGRADES were acknowledged & congratulated
OLD BUSINESS Awards not claimed at Christmas Party were handed out
RELOCATION of County OES briefly discussed
HARRY STYRON K6MFV gave an update on the Clayton Antenna Petition
TREASURER Mary N6ELM reported that we have $855.92 in checking and $537.17 in savings.
EDUCATION Guy WD6G reports the FCC exams going great and gave thanks to those who helped. 46 people registered 9upgraded to tech. 2 to general and 5 to advanced Next exams will be May 3rd and 4th Walk ins will be allowed
FIELD DAY Chairman Guy WD6G informed us that the theme for Field Day '85 is WE WILL WIN"
SOCIAL CHAIRMAN Vickie N6ELS urged everyone to turn in the survey that was printed in the CARRIER
SPECIAL EVENTS Headed by Mike Scott N6GOZ will take place sometime in April Location Montgomery Ward Shopping Center where a multi mode operation will take place in conjunction with the
Space Shuttle in which another ham will communicate from space The multi mode will include 450. 2 meters 220. ATV and OSCAR It will be operational for 24 hours per day for 5 days Volunteers will be needed to man the stations around the clock
PARKY NET Lots checking in says Parky
MEMBERSHIP Jim KA6IVF reports we have 135 members at present.
AUCTION CHAIRMAN John WA6SWO reports that March meeting will be the Auction Doors open at 6:00 PM auction at 7:00 PM
MDARC NET Net control Jay KT6Y urges all to check in
REPEATER Chairman Bob KA6LSL reports repeater doing better and would still like people to monitor interference
Thanks to Francis for the delicious home made cookies
After a short break for cookies and coffee we had a great talk by Dave Tyler who explained the function of the OES
Meeting adjourned at 10:10

Respectively submitted
Dee Barber N6EJU Secretary

# MDARC BOARD MEETING

MDARC Board Meeting Feb 18, 1985
QTH Residence of Rick and Dee Barber

The meeting was called to order at 8:10 by our President Rick Barber WB6EZI
Board Members present were Jay KT6Y Nancy N6ELM Dee N6EJU Rick WB6EZI Scott WB6POM Jim KA6IVF and Guy WD6G
Members present John WA6SWO Vickie N6ELF Jim KE6RV Glen N6JRE and Chuck KB6UY
M M S P that minutes be approved as printed in the CARRIER
NEW BUSINESS Discussion to place concerning Field Day operation It was finally agreed that Field Day would be open to all interested parties subject to approval of Field Day Chairman Guy WD6G
A long discussion took place regarding control operators
M M S P that R R R G be contacted and informed that the following persons should have on off and phone patch codes for emergency Chairman R R R C President MDARC Trustee Technical Chairman and Emergency Coordinator
CHRISTMAS PARTY long discussion took place concerning Christmas Party question of the evening was Pot Luck or Catered M M S P that other facilities be explored for possible Pot Luck
SILENT KEY NAME PLATES to be added to Silent Key Plaque
JAY KT6Y to contact Bob Richter concerning station license
AUDIT M M S P that Mary N6ELM Scott WB6POM Rick WB6EZI comprise the Audit committee
AUCTION CHAIRMAN John WA6SWO explained the Auction Rules M M S P that John be given $25.00 to finance March Auction
TREASURER Mary N6ELM reported $855.92 in checking and $537.17 in savings
MEMBERSHIP Jim reported that we now have 152 members Proof sheet to be sent out to members to insure correct mailing information
SOCIAL Vickie N6ELS reported that the survey results showed that most wanted wine country tour and picnic should be dropped this year
Meeting adjourned at 9:55 P.M

Respectively submitted
Dee N6EJU Secretary

## *The President's Corner....*

Spring has sprung! At least for this week anyway. Time to start thinking about getting all the antennas back in shape and working to the max. I just finished moving the station to the new shack and rearranging things to work together more effectively. Sure makes a person feel good to have things working together and also makes one think about what should be different about the gear or shack.

Those musings bring to mind that the auction is this month and a good time for everyone to look for bargains. There might be just that one piece of equipment you need to make a big difference in your operation, no matter what your interest in ham radio. What with all the new gear on the market, many people will be looking to get rid of some of their outmoded gear. Like a wise man once said, "What is junk to one is treasure to another." Wonder what treasure is going on the auction block this month.

I remember some fine equipment going for very reasonable prices last year. This should be a good time to look over the equipment in your shack, decide what's "surplus" and bring it down to sell. Who knows, I may even bring down my mint R-390 or 2KW linear.

I just want to add my personal request to those you hear every year. Please look over the gear you want to bring to make sure it falls into the "usable" category and not into the infamous "junk" area. Just doesn't make too much sense to have to lug it to the auction and then back again or to the dump. Be realistic and get a second opinion if you aren't sure.

The doors at the church will open at 6:00 PM and the auction will start at 7:00 PM. For further details see John's article elsewhere in this CARRIER. SWO has done a fine job and I am sure this will be one of the better auctions the Club has put on. Thanks for your fine efforts, John.

So with that, the best of everything to everyone and keep coming to the meetings. The attendance has been super and the interest high!

de Rick WB6EZI



## RADIO CLASSES

EDUCATION REPORT
by Guy WD6G

We are currently in the eighth week of our 13 week amateur radio course program. This program offers classes ranging from novice to and including extra class and is organized to prepare prospective upgrade applicants for the FCC exams. These will be held on the 3rd and 4th of May at College Park High Wing H in Pleasant Hill. For the first time walk-ins will be allowed on a seat availability basis. Anyone wishing a guaranteed seat should mail the required forms and fee to the Volunteer Examiner liaison WD6G (Guy) at least 30 days in advance of the session. We need the completed FCC form 610, copy of license and $4.00 made out to the ARRL VEC. For further information call Guy at 837-3080 or Jay (KT6Y) at 939-1893.

## Renewing

ARRL MEMBERSHIPS

Don't forget to renew your ARRL membership through the club. Send us the card and money. We foreward to the ARRL and get to keep $2.00.

# RACES/ARES

E C REPORT

by Guy WD6G

The monthly OES E C meeting took place in Martinez (at OES) on February 7 No critical issues were discussed, although some topics deserve to be summarized here

The Clayton antenna ordinance was discussed from an emergency communications perspective and a consensus was informally reached by the E C 's, S E C , and other attendees that, although good antennas are crucial in providing effective emergency communications, that argument should not be abused. When the purpose and legitimacy of their antenna structures is being questioned by neighbors, amateurs often respond by stating that their antenna system - and often their whole station - is essential for their emergency communications work If these hams have demonstrated a verifiable commitment to emergency communications using the station in question, this response is appropiate and provides an improved appreciation by the community of the amateur radio service goals and activities

If on the other hand, there is no evidence that the station and its antenna structure are intended at least in part - for emergency communications and that no significant emergency or public service traffic has flowed into or out of the station in recent times and on a somewhat regular basis then the argument is being abused Such an abuse may not only impair the station in question, but will almost certainly affect the credibility of the amateur community at large Other operators, whose emergency communications argument is legitimate, may not be accorded the support they deserve, and amateur radio may suffer a serious credibility problem So, if we are going to employ the "emergency communications defense", let's at least demonstrate a modicum of interest in amateur emergency communications

On another topic, a brief scenario simulation was presented to us by Dave Tyler, N6DRT He presented a scenario (realistic, he says) where due to increased international tension about 100,000 repatriates would have to be processed and funneled via a single Air Force base in the bay area It was soon obvious to all of us that the physical logistics and the communications problems would be staggering Ham radio would be expected to provide all health and welfare traffic via the National Traffic System (NTS), and a local communication network would have to be devised. How such a network would be constructed was a mystery and appears unresolved at this time

# NET

M D A R C GENERAL NET

The MDARC General Net started February 21 1985 for the first time This net will meet every Thursday evening at 7 30 P M local time on the two meter 147 06 Club repeater Net Control will be ET6Y Jay and the alternate net control will be WB6EZI Rick

The purpose of this net will be for Club members and guests to check into a net and pass emergency messages, make announcements, meet fellow amateurs and anything else that may be pertinent As the net progresses we may add a swap feature for equipment that you may want to offer to others

I plan to call a roll of those who check in regularly If a station hasn t checked in for four (4) consecutive weeks he/she will be dropped I plan to call roll by the alphabet from the beginning one week and from the end the next and maybe even from the middle That way the Z's will not have to wait every week for their call

The first session was a success Emergency traffic information was passed A sad Silent Key was announced Up coming events were announced and 23 members and guests checked into the net

I hope more of you who are not doing anything on thursday evening at 7 30 will check in If you are so inclined you may want to go out to your shack a half hour earlier and check into the RACES net at 7 00 P M on 146 430 simplex and the 147 735 repeater Plan to spend an hour those evenings on two meters See you on the NET

Jay D Caldis ET6Y

# miscellaneous

ATTENTION PLEASE

IF YOU MOVE, ADDRESS ALL ADDRESS CHANGES TO THE MDARC MEMBERSHIP CHAIRMAN NOT THE CARRIER EDITOR.

The membership Chairman is responsible for maintaining an up to date mailing list. Send your address change in care of the Editor only delays the change. Thanks

Ed

## AUCTION RULES

- AUCTION -
March 15, 1985

- Doors open at 6 PM. Bring your items to get them marked at that time.

- Auction starts promptly at 7 PM.

- Business meeting 8:00 - 8:15 PM.

- Prime Time 8:15 - 9:15 PM. Doors close at 10:00 PM.

RULES

1) MDARC Commission 10% of purchase price up to $10 maximum.

2) Buy backs (where bid does not reach sellers value seller buys back) 10 % Club commission applies but with $1 maximum.

3) The Club gets a straight 10% of a deceased persons equipment.

4) Donations accepted. If you want the Club to get a full 100% please say so on items tag.

5) Everyone seller and buyer gets a numbered card. Hold up when you bid.

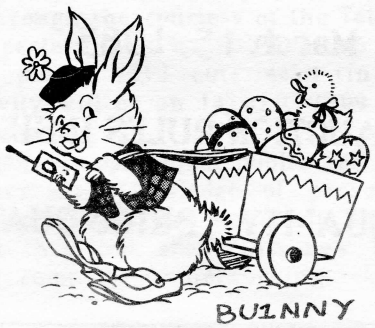
6) All sellers may have no more than three items sold during Prime Time.

7) Sellers tags (attached to each item) will have spaces for silent bids prior to auction time. A minimum bid written on the tag by the seller will be regarded as the opening bid and subject to buy back rules.

8) Bids will be no less than in .50 increments.

9) Pay the Club, not the seller. He gets his later minus the Club's commission.

10) All sold and unsold items must be removed at at the end of the Auction (10 PM).



FEDERAL COMMUNICATIONS COMMISSION
FIELD OPERATIONS BUREAU
SAN FRANCISCO REGION

PUBLIC NOTICE:
CONSPECTUS OF 1984 SAN FRANCISCO BAY AREA AMATEUR RADIO CASES.

FCC facilities in the Bay Area regularly receive complaints of misbehavior on amateur radio frequencies, particularly alleged malicious interference to amateur repeater stations. In an effort to meet a consistent query for information, amid conflicting cries for "free speech" and "punishment," this release to the local amateur community summarizes the primary developments for cases in and around San Francisco during 1984.

KERR (EX-WA6JIY) - FEDERAL COURT DISMISSES CRIMINAL CONTEMPT CHARGE - ORDERS $300 PAYMEN - BANS HIM FROM AMATEUR BANDS FOR ONE YEAR:

Without admitting legal liability for alleged past infractions, GARY W. KERR of Palo Alto, California, has now tendered payment of a reduced $300 fine and agreed to a one-year federal court consent order barring any use of amateur radio equipment and any transmissions on amateur frequencies. (The injunction also specifically prohibits transmissions made under the supervision of other licensed control operators.) This action represents somewhat of a milestone in the Kerr case. The FCC district office had fined Kerr $2000 for unlicensed operation observed at 5:13 PM, April 13, 1983, on 147.930 MHz, input to the popular local 147.330-MHz "Mt. Tam" repeater (K6GWE). He refused to pay the fine and was noted to continue operating on multiple dates through January 1984. The case was therefore referred to the office of Joseph P. Russoniello, United States Attorney, Northern District of California. Assistant U.S. Attorney Stephen A. Shetler filed suit in April in U.S. District Court seeking both a judgement for the $2000 fine and an injunction barring further illegal radio transmissions. At an October 3 preliminary hearing, Judge Spencer Williams temporarily enjoined Kerr from further broadcasting pending a final hearing in the case.
Kerr reportedly continued his radio operations, and at a November 5 court hearing the government pressed a charge of criminal contempt for violation of the temporary injunction. Judge Williams dismissed the contempt charge, based at least in part on conflicting legal advice and testimony concerning the "control operator" provision mentioned in Section 97.79(d) of FCC Rules. At a continued November 9 hearing the parties had reached agreement stipulating a $300 payment and a one-year injunction, thus avoiding further and possibly protracted civil proceedings before the court.
The Kerr case goes back several years. Briefly, as a former General Class operator and licensee of station WA6JIY, he was issued a violation notice for causing intentional interference to local 2-meter repeaters and other infractions noted in August 1980. His recently-renewed license was set aside by the Private Radio Bureau, followed by a formal hearing before an Administrative Law Judge in San Francisco. He then appealed to the FCC Review Board in Washington, which affirmed the denial of his license in August 1982.

ALLEN (KB6DPX) PAYS $1000 FINE FOR OUT-OF-BAND SURRENDERS LICENSE
FRANCIS P. ALLEN, SR., San Jose, California, was caught operating SSB substantially outside the 10-meter band at 12:42 AM, March 30, and fined $1000 for willful violation of the Communications Act. Allen surrendered his Novice Class amateur license and because of his subsequent candor and cooperation he was permitter to make $200 monthly payments starting in June. The final installment was received in mid-October.

LICENSED HAM ISSUED VIOLATION NOTICE FOR COMMUNIDATING WITH UNLICENSED STATION
In connection with the above Goto case, a licensed General Class amateur operator, holding a WA6 station license in Oakland, California, was observed in communication with the unlicensed Goto at 8:45 AM September 25. Engaging in communication with a station not authorized for amateur operation is a violation of Section 97.89 (a) (3) of FCC Rules, and an Official Notice of Niolation was issued to the licensee. He has not seen fit to reply to the Notice or a certified follow-up warning. Continued failure to reply will routinely result in referral to the Private Radio Bureau, typically for license revocation proceedings, at which time his identity may be made public.

FOURTH ANNUAL ARRL COMPUTER NETWORKING CONFERENCE TO BE HELD IN SAN FRANCISCO. MARCH 30TH - 10:30 AM TO 6:00 PM!

What many consider to be the most sophisticated, exciting, and beneficial mode of amateur radio, i.e. PACKET RADIO, will be the focus of attention at the FOURTH ANNUAL COMPUTER NETWORKING CONFERENCE sponsored jointly by the American Radio Relay League of Newington, Conn and the Pacific Packet Radio Association (Northern California's pioneering Packet Radio group). The conference will be held in conjunction with the Tenth West Coast Computer Faire, which runs from March 30th through April 2nd at San Francisco's new Moscone Convention Center. The tremendous growth and interest in packet radio terminals, equipment, networks, and applications promises to make this conference one of the largest and best attended.

The networking Conference and all the other activities of the FAIRE will be held inside the Moscone Center in downtown San Francisco. To attend you will need an entrance ticket to the Faire. All Faire visitors may attend the ARRL Conference at no additional charge. This Faire by the way, has been the premium Computer Faire in the entire Nation for many years. The Faire hours for exhibits and sessions are 10 AM to 6:00 PM daily March 30th through April 2nd. The ARRL COMPUTER NETWORKING CONFERENCE will be held all day Saturday, March 30th from 10:30 AM to 6:00 PM in room 232 in the East Wing of the Moscone Center near Third and Howard. The technical sessions are scheduled as follows:

March 30th SAT

10:30- Opening remarks and keynote-Paul Rinaldo W4RI

10:45- Pete's Packet Primer by Pete Eaton WB9FLW

11:30- Applications of Packet Radio - Papers

12:00- Applications Panel Discussion by Andy Cromarty N6JLJ

12:30- Lunch Break. Location to be announced

1:30- Technical Papers on Packet Radio and Digital Communications

3:15- Technical Papers on Packet RAdio and Digital Communications. Presentations from the proceedings. Part

6:00- End of Technical Sessions

8:00- Conference Dinner. Location and Price to be announced.

A voice coordination frequency has been approved through the courtesy of the Telephone Pioneers Repeater Group. WE6FDT/R on 146.19/.79 (n/out) coupled to 443.1 (out) /448.1 (in). Local Packet activity will be on 145.01.03.05.09. 223.58, and 146.58 Mhz.

All sessions are open to the public and persons with no previous knowledge of packet radio systems and procedures are welcome to sit-in and learn what they can about this new area of personal computer networking. On-site registration for one day is only $12. A special pre-registration fee through special arrangements with the ARRL and the FAIRE of $20 will purchase a four day ticket to the Faire and a complete set of the ARRL Printed Proceedings of the Computer Networking Conference for the special pre-registration price. checks must be received before March 16th payable to H Magnuski and mailed to him at 311 Stanford Ave Menlo Park CA 94025 telephone 415-854-1927. Any questions about the Computer Faire itself may be directed to Computer Faire Inc 611 Veterans Blvd. Redwood City CA 94063 telephone 415-364-4294. There are plenty of hotels/motels in the area and San Francisco should have pleasant weather and suitable accomodations for all who are traveling from afar. A good opportunity to get the inside dope on the newest and most exciting happenings in radio digital communications and electronics!

Donald Simon NI6A

C.C. ATV GROUP

C.C. ATV group has been very active in recent weeks.

The ATV repeater was hauled off the Mountain (yes, again) and sent off to Sacramento to be overhauled by Bill K6LXW. After a couple of weeks up there it was returned to the hill top and is now fully operational with P-5 pictures received in Sacramento, Grass Valley and Nevada City. Bill W6ZUZ is planning a trip to Tahoe and hopes to take along his TV equipment to try the repeater from there.

More Club members are getting active on ATV, those known to have ATV receive or transmit capability include Don WB6TEE, Joe KD6DY, John WA6DPG, Rick WB6EZI, Don W6NKF, Bob KA6LSL, Don, WB6VHW, Mike, N6GOZ. If there is any one else we don't know about. Please Call W6NKF at 372-8777 and inform him of your capabilities.

Future activities planned for the repeater include live uninterupted coverage of upcoming space shuttle flights, airborne TV, and various educational documentarys.

The repeater is running test patterns on a regular schedule to help get your equipment on line. Time schedule is Monday through Friday 5 AM-7 AM, 2 PM-3 PM, 7 through 10 PM. This schedule is added to during weekends with longer operating periods.

Output off the repeater is 434.00, so program your scanners and listen for the pulses at the above times. (sounds like someones sitting on their mike button) If you can hear us, you can probably see us. So go out and buy some ATV equipment and JOIN THE FUN BUNCH on Amateur Television.

Mike, N6GOZ

# TECHNICAL CORNER

Tech corner Guy Corynen WD6G

PREFACE

In the last issue of the CARRIER we presented the first chapter of a paper on the radio frequency (RF) interference between FM transceivers and we emphasized interference problems between repeaters. As stated, the purpose of the paper is to assist FM transceiver and repeater operators in assessing and reducing interference problems, and to provide a technical basis on which the FCC and local coordinating groups can develop defensible band plans for repeater operation. We intend to achieve this goal by developing a graph or chart - like a Smith Chart - with which users, repeater designers or regulators can quantitatively determine those critical combinations of output power, frequency of operation, distance between transceivers, antenna gains, system losses and other important parameters for which interference conditions will prevail. We expect that this chart will demonstrate definitively that some repeaters currently in use or in the planning stage are bound to interfere with each other unless special precautions are taken, and we shall discuss some of them in a later chapter.

In the first chapter a complete electromagnetic coupling analysis produced a simple but useful formula for determining the RF voltage produced at a receiver by a transmitter operating at a given power, distance and frequency, and accounting for the various losses and pairs in bothe the transmitter and the receiver. To understand the importance of this equation, we repeat it below and provide a simple numerical example.

$$V_{IN} = \left[ 3Z_{IN} \eta_R \eta_T \lambda^2 G_R G_T P_{OUT} (1-\ell_T)(1-\ell_R) \right]^{1/2}$$

Consider an application where two transceivers have the following characteristics:

Receiver input bandwidth: 13 KHz (assume perfect skirts)
Transceiver input impedance ($Z_{IN}$): 50 Ω
Receiver and transmitter antenna efficiency factors ($\eta_R, \eta_T$): .9
Wavelength of operation ($\lambda$): 2 meters
Antenna gains ($G_R, G_T$): 5
Distance (d) between transceivers: 30 kilometers
Output power of the transmitter ($P_{OUT}$): 100 watts
Transmitter and receiver transmission efficiency factors ($\ell_T, \ell_R$): .05

After plugging all these values into the above equation (for this transceiver pair) we get a receiver voltage of 15 millivolts. This is a pretty strong receiver signal, but note that only the free-space path loss ($1/d^2$) was accounted for in our analysis. In practical cases even when line of sight is preserved, considerable attenuation can be experienced, but a study of this attenuation is far beyond the scope of this paper. Even when other path losses are significant, however, our analysis is still valid. It suffices to add another loss factor like $\ell_T$ OR $\ell_R$ in the above equation. If topographical conditions are so complicated that this factor cannot be estimated with current theories it is easily determinable experimentally.

CHAPTER 2 SPECTRAL ANALYSIS

In the previous chapter, we derived an expression for the signal strength at a receiver's terminals resulting from an RF carrier generated by a transmitter some distance away.

In this chapter we extend the analysis to a spectrum of signals, not just a single-frequency carrier. The objective is to determine the received signal strength across an entire frequency band resulting from a typical FM transmitter. As we mentioned in our introduction, FM signals possess sidebands to infinity, and one objective of this paper is to determine how much sideband power bleeds into adjacent channels. We do this in several steps. First, we provide a brief review of current FM technology, commercial and amateur, and present a functional description of a typical transmitter. Then we present a simplified discussion of FM and PM (Phase Modulation) theory required to determine the output spectrum of a typical FM or PM transmitter. Next we compute that spectrum and derive the proportion of transmitted power spilling into adjacent channels.

2.1 Functional Description of Current Amateurs FM Transmitters

The principal consideration in the development of various angle modulation schemes in the thirties was the expectation that the signal-to-noise ratio of typical communications would be considerably improved with such new approaches. Whether the noise originated in the communication medium or in the processing hardware, this expectation was fully realized. However, it was soon realized that this new benefit was only available at the expense of a considerable increase in bandwidth requirements, potentially infinite. Various improvements were then considered over the years. One of the first was narrow band FM which we discuss a bit later. Whereas this scheme was used for several years its principal disadvantage was not suspected until a thorough spectral analysis was cunducted. It was then discovered that narrow-band FM in fact differed very little from A.M. and that no noise rejection improvement was obtained with it. The technology then shifted towards medium or wide-band FM and it is still in use today.

One improvement, referred to as pre-emphasis, did lead to better noise rejection, however at no expense in bandwidth. This scheme is based on the fact that the frequency spectrum from the RF signal is determined by the maximum modulation (audio) frequency, but that the audio power is

quite small at the upper end of the audio spectrum. Indeed, the power density of typical voice signals is highest at the lower end of the audio spectrum, and drops off quite rapidly as the upper end is approached. Since the noise power is usually uniform across the audio spectrum, a natural method to avoid that the high frequencies be swallowed up by the noise is to "equalize" the audio power distribution by emphazing the higher audio frequencies with an audio shaping network called a Pre-emphasis circuit. With such a circuit, maximum deviation is produced most of the time, thereby maximizing power and spectral efficiency, similar to what is done with SSB speech processors. At the receiving end, this process is "undone" with a de-emphasis network.

Another major improvement surfaced when it was discovered that phase-modulation signals are considerably more noise - resistant than frequency - modulation signals. This discovery let to another audio transformation which allows frequency-modulation signals to be transmitted as phase - modulation signals and led to the now popular "Indirect F M Method" also called the "Armstrong Method".

Summarizing all these developments, current F M transmitters are constructed in accordance with the functional diagram of Figure 3. Referring to this figure, the purpose of the multiplier is essentially to increase the modulation index from a narrow-band value to a medium or wide-band value. The other functions were discussed earlier.

## 2.2 Spectral Theory of Angle Modulation

In this section, we summarize the results of a complete analysis, which is reported in detail elsewhere [3]. The objective is to provide "CARRIER" readers with the minimal amount of facts needed to appreciate and discuss the serious interference problems which can arise in FM communications. We do this in three steps. First we tell the reader where the sidebands of an F M signal are located. Then we state how large these sidebands are. Finally, we show how much sideband energy or power is spilling over into adjacent channels under normal operating conditions. Much of the theory supporting our analysis can be found in Schwartz [2], where both F M and P M are defined to be special cases of "Angle Modulation". We start with some definitions.

Most readers know that the deviation $\Delta f$ of an F M transmitter is the maximum difference between the R F frequency of the output signal and the nominal carrier frequency. In amateur equipment deviation on 2 meters rarely exceeds 3 KHz, occasionally 5 KHz, and usually exceeds 5 KHz. We thus assume a typical deviation of 5 KHz, although our conclusions are not very sensitive to this assumption.

Deviation is sometimes confused with bandwidth or other parameters related to the output frequency spectrum. Although deviation influences the bandwidth of F M signals, other parameters such as deviation ratio and maximum audio frequency are much more important in determining bandwidth, as we show later. The deviation ratio is a quantity $\beta = \frac{\Delta f}{f_m}$, the ratio of deviation $\Delta f$ to the maximum modulating (audio) frequency $f_m$. In amateur systems $f_m$ equals about 3 KHz, so that the deviation ratio equals 2. Amateur F M is thus wideband F M ($\beta > \pi/2$).

For an F M signal for which $f_m$ is 3 KHz, the sideband pairs are located 3 KHz, 6 KHz, 9 KHz, and so on away from the carrier frequency. For a nominal carrier frequency of 150 MHz, for instance, the first pair is located at 150 ± 3 KHz, the second at 150 ± 6 KHz, and so on.

The amplitude (size) of these sidebands are found with Bessel functions [2,3], and are determined by the deviation ratio $\beta$. For our study, $\beta = 2$, and these magnitudes are plotted in Figure 4.

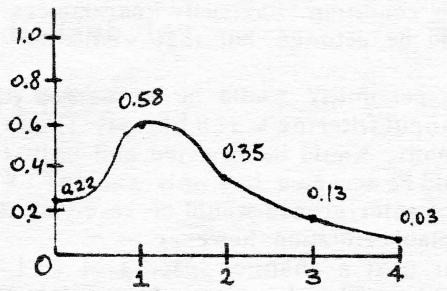



Figure 4. Relative magnitude of the first four pairs of sidebands for an F M signal with deviation ratio $\beta = 2$.

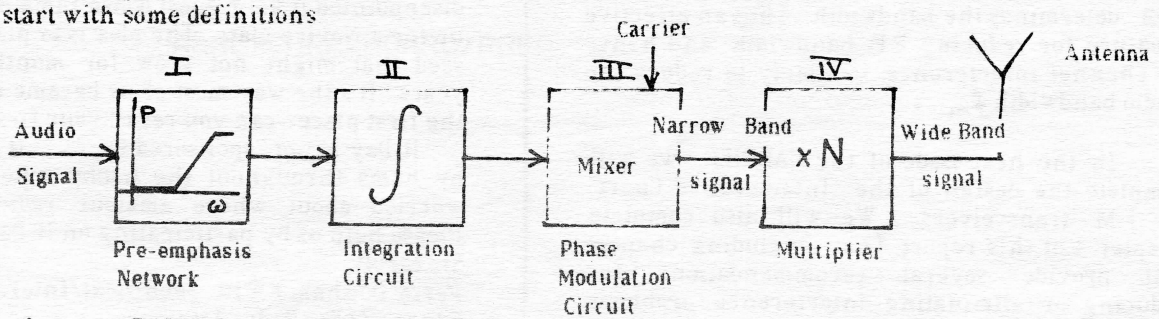



Figure 3. Current F M transmitters typically perform the four functions shown.

Now consider the problem of computing the total sideband energy delivered to a receiver with an input bandwidth of 13 KHz and operating in the center of a adjacent band whose width is 15 KHz, when the nominal carrier frequency is 7.5 KHz away from that band. Considering Figure 4, only the third and fourth sidebands fall inside the adjacent channel and since the fourth is considerably smaller than the third it may be neglected. Converting this to sideband power we find that the amount of power spilling over into the adjacent receiver is thus $(0.13)^2 = 0.0169$ times the total power received. Combining this result with equation 1 we find that the voltage produced at the receiver inside the adjacent channel is 0.13 times the voltage produced inside the main channel. This is a very large number and indicates that the co-channel interference is intolerable. Consider thus two receivers with identical characteristics (parameters of equation (1)) and tuned to receive on neighboring channels having a width of 15KHz. Then any transmitter with the characteristics of Eq (1) which transmits an FM signal on one channel will cause significant interference to the other receiver. In particular any two repeaters with the same characteristics but operating with inverse splits on adjacent channels of width 15 KHz will lock up. For a more conclusive proof consider our earlier example where the receiver voltage was 15 millivolts. The adjacent repeater will then receive a $15 \times 0.13 = 2.0$ mV. signal in its input band and both machines will definitely lock up.

One remedy to this situation is to raise the squelch setting of both machines to 2.0 mv a undesirable condition. Obviously parameters of Eq (1) could be detuned but that would not be efficient.

Anothe possibility would be to narrow the receivers input filtering to 11.0 KHz say. Then the third harmonic would be rejected and only the fourth would be accepted. Now only about $0.03 \times 15 = 0.45$ mv of interference would be received still an unacceptable situation however.

Consider next a channel spacing of 20 KHz. Then only the fifth sideband would spill into the adjacent receiver's passband. This would be a much more desirable condition. Finally consider the fact (proved in [3]) that the maximum modulating frequency, and not the deviation ratio $\beta$ determines the bandwidth. Thus an effective measure for reducing RF bandwidth and hence co-channel interference is simply to reduce the audio bandwidth $f_m$.

In the next issue of the CARRIER we will complete the design of the "Interference Chart" for FM transceivers. We will also complete chapter 3 of this report. That concluding chapter will provide several recommendations for reducing or eliminating interference problems which currently threaten the harmonious coexistence of amateur repeaters.

Guy Corynen WD6G

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[1] Charles L. Hutchinsen K8CH, "The ARRL Handbook for the Radio Amateur", the American Radio Relay League (ARRL), Newington, Conn 06111, 1985

[2] Mischa Schwartz "Information Transmission, Modulation, and Noise" McGrew Hill 1970 (Second Edition)

[3] G.C.Gorynen "Electromagnectic Interference Between F.M. Transceivers" Submitted to QST for publication April 1985

# H-DAY

CW COMMUNICATIONS, PETERBOROUGH

Dear Friends

Amateur radio in the United States is in serious trouble. Our hobby has experienced a steady decline in the number of licensed operators over the past several years and we are continuing in this downward spiral. Increasingly the FCC has followed a policy that caters to commercial interests at the expense of ham radio. And ham equipment manufacturers are heading for the lifeboats, some staying afloat by expanding into other markets, others sinking tragically into the mire.

Each one of us is threatened. There are no guarantees that amateur radio will survive to the end of the decade. Can you imagine life without it?

Here's what you can do. On Sunday, March 24th, invite one person into your shack for a live demonstration of amateur radio. We call it Ham Day or H-Day. It's very simple: don't worry about making a big dinner or anything, just have someone over and expose them to ham radio for an hour or so. Use whatever mode you feel comfortable with, but try to keep things at a level your guest can understand. The idea is to interest them, not scare them!

Tell every ham you know about H-Day. Invite someone over on the 24th. Thousands of hams will be on the air just for H-Day, so you shouldn't have any trouble finding a QSO. And remember, don't be disappointed if your guest doesn't immediately sign up for a Novice class. The idea is to plant a seed, a seed that might not grow for months or even years. It's the way most of us became amateurs in the first place--can you recall your first exposure?

H-Day is not "sponsored by 73." It's sponsored by hams throughout the hobby who are really worried about where amateur radio is going. Please help us by participating on H-Day.

Sincerely,

Perry Donham KW10, Technical/International Editor, 73 for Radio Amateurs

## Membership

NOTICE FROM THE MEMBERSHIP CHAIRMAN!

Please check the enclosed label for any mistakes and correct any you find.

Mail this form and attached label to the Membership Chairman as verification of your corrected address.

The information shown on this label will be appearing in the membership directory.

Thank you very much.

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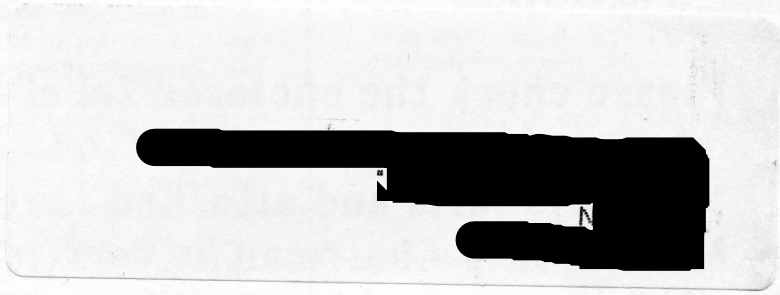

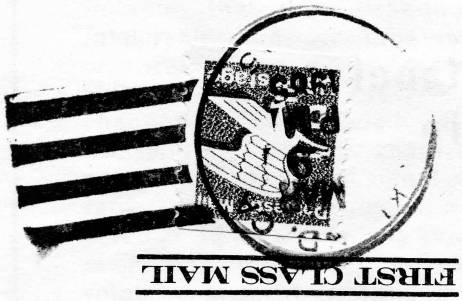


From:
Mt. Diablo Amateur Radio Club, Inc.
P.O. Box 23222
Pleasant Hill, Calif. 94523
Affiliated with the ARRL
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# HAM SWAP

13th annual HAMSWAP to be held Sunday, May 5th, 1985 at the Placer County Fairgrounds in Roseville, California (north east of Sacramento).

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FREE PARKING - FREE ADMISSION - FREE DOOR PRIZE

Food & Refreshments - Hourly Raffles - Club Auctions
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Fun, Food and Raffles until 3:00 PM
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Advanced (reservation) table sales...$ 6.00/table (before 4/15/85)
On-site table and tailgate sales...$ 8.00/table or tailgate location

TALK-IN on K6IS Repeaters: 145.19 (-) & 224.78 (-)

Telephone message: (916) 366-9111 or write to:

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